Перевозников С.С., Цыбульская Л.С., Позняк С.К. и др. Опубл.30.08.2013г., БИ №4.

3. Wang Y.F., Fu W.G., Feng M., Cao X.W. Investigation of the structure and the physical properties of nickel-phosphorus ultra-black surfaces // Appl. Phys. A. 2008. Vol. 90. P. 549–553.

4. Randin J.-P. Hintermann H. E. Evidence of nickel phosphide Ni_2P in as-plated electroless nickel // J. Electrochem. Soc.: Electrochemical Science, 1968. Vol. 115, № 5. P. 480 – 484.

UDK 544.6

D.S. Kharitonov[1], PhD student,
A. Wrzesinska[2], PhD student,
M.A. Osipenko[1], Student
I.M. Zharskii[1], PhD, Professor
I.I. Kurilo[1], PhD, Docent, Head of Department.
([1]BSTU, Minsk, email: kharitonov@belstu.by, kurilo@belstu.by;
[2]Lodz University of Technology, email:801106@edu.p.lodz.pl)

EFFECT OF SODIUM VANADATE ON CORROSION OF AA6063 ALUMINUM ALLOY IN ALKALINE MEDIA

The AA6xxx aluminum alloys being extensively used in building and chemical industries for producing roofing panels, chemical equipment, gas lines, gasoline tanks and heat exchangers due to their attractive physical properties such as high mechanical resistance, tensile strength and good formability values are prone to localized corrosion in the form of pitting or intergranular corrosion [1]. Active pitting corrosion of aluminum alloys results from the presence of intermetallic particles which are acting as local anodes or cathodes, leading to localized dissolution of aluminium matrix or selective dissolution of intermetallic particles [2].

One area of current research in the field of corrosion inhibitors is focused on oxoanions with general formula $Me^{n+}O_4^{(n-8)}$ which are similar to chromate anion CrO_4^{2-}. Molybdates, permanganates and tungstates are among the most promising inhibitors of such type [1]. Much attention as corrosion inhibitors for aluminum alloys was recently paid to vanadates (VO_4^{3-}) [2, 3]. This study aims to investigate the possibility and mechanism of corrosion inhibition of aluminum AA6063 alloy by vanadate aqueous species in alkaline solutions.

All corrosion tests were performed on a 2 mm thick AA6063–T6 samples with 2 × 2 cm surface size in 0.05 M sodium chloride alkaline so-

lutions (pH 10) with 0,003 mol/l of sodium orthovanadate. The initial pH value of solutions was corrected to pH 10 by Schott Titroline titration system with 0.1 M sodium hydroxide or nitric acid solutions.

At pH10 tetrahedrally coordinated monovanadate VO_3OH^{2-} and pyrovanadate $V_2O_7^{4-}$ ions are dominating species. Decreasing of pH due to local acidification in pitting areas of Al surface promotes polymerization and formation of hydrated monometavanadates $VO_2(OH)_2^-$ and polymetavanadate $V_3O_9^{3-}$ ions.

In alkaline sodium chloride solutions AA6063 alloy undergoes severe pitting corrosion due to aggressive hydroxide and chloride ions and presence of cathodic and anodic intermetallic particles in the structure.

Upon addition of 0.003 M vanadate in NaCl solutions OCP of AA6063 shifts in cathodic region to 30–40 mV after times on the order of hours. Polarization measurements indicated mixed anodic-cathodic type of inhibition. Corrosion current density in vanadate containing alkaline solutions decreases up to an average order of magnitude.

Electrochemical impedance spectroscopy measurements recorded for AA6063 alloy in alkaline solutions in the absence of vanadate inhibitor showed two capacitive loops due to the heterogeneity in the microstructure that leads to localized corrosion. In vanadate-containing solutions one capacitive loop and significant increase in surface's resistance proving corrosion inhibition was observed.

Mechanism of corrosion inhibition of AA6063 in alkaline solutions by vanadates likely includes both formation of a polymerized vanadate film on anodic cites and adsorption of vanadate ions on more noble cathodic cites, suppressing cathodic reduction reaction. The formation of a polymerized vanadate film is probably critical factor in corrosion inhibition mechanism.

REFERENCES

1. G.M. Scamans, N. Birbilis, R.G. Buchheit. Corrosion Resistance of Aluminum and Magnesium Alloys: Understanding, Performance, and Testing. – New York: John Wiley & Sons, 2010. – P. 123–175.

2. Kharitonov, D.S. Corrosion inhibition of AA6063 alloy by vanadates in alkaline media / D.S. Kharitonov, I.I. Kurilo, A. Wrzesinska, I.M. Zharskii // Mat.-wiss. u. Werkstofftech. – 2017. – Vol. 48. – P. 646–660.

3. Харитонов, Д.С. коррозионное поведение сплава АМЦ в щелочных средах в присутствии ортованадата натрия // Д.С. Харитонов, И.И. Курило, И.М. Жарский // Свиридовские чтения. – 2016. Вып. 12. С.117–128.